

Fig. 1

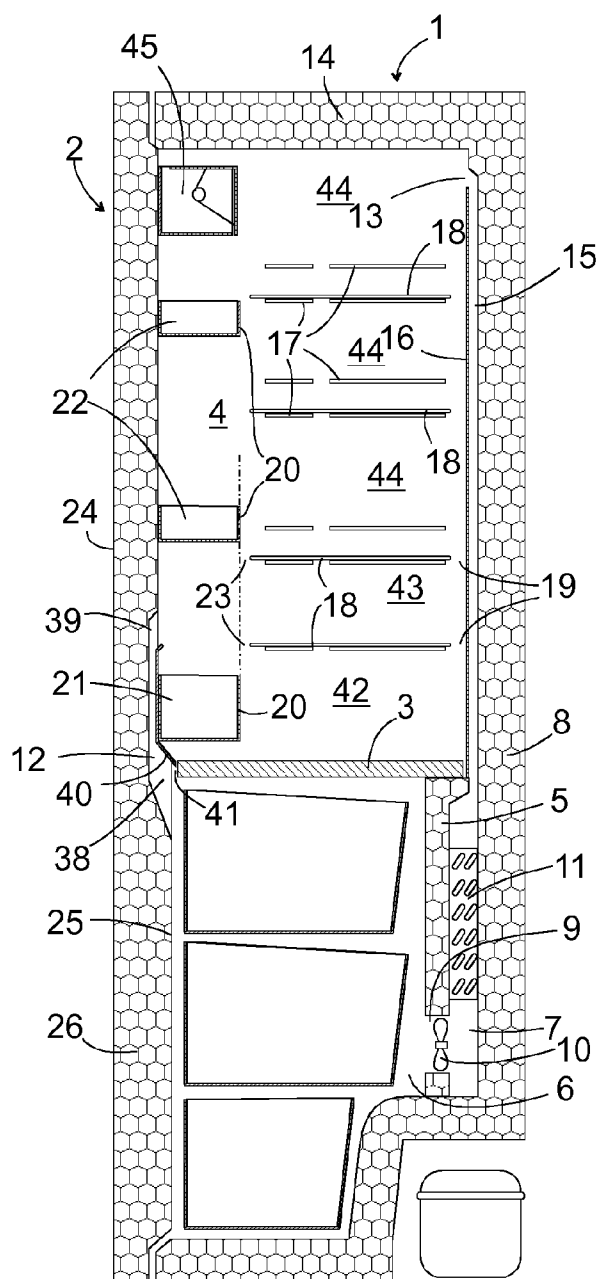


Fig. 2

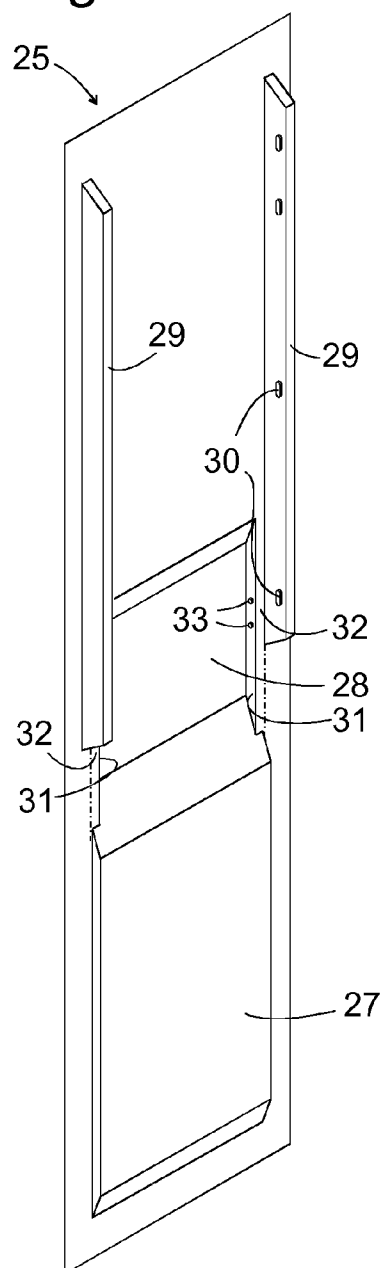


Fig. 3

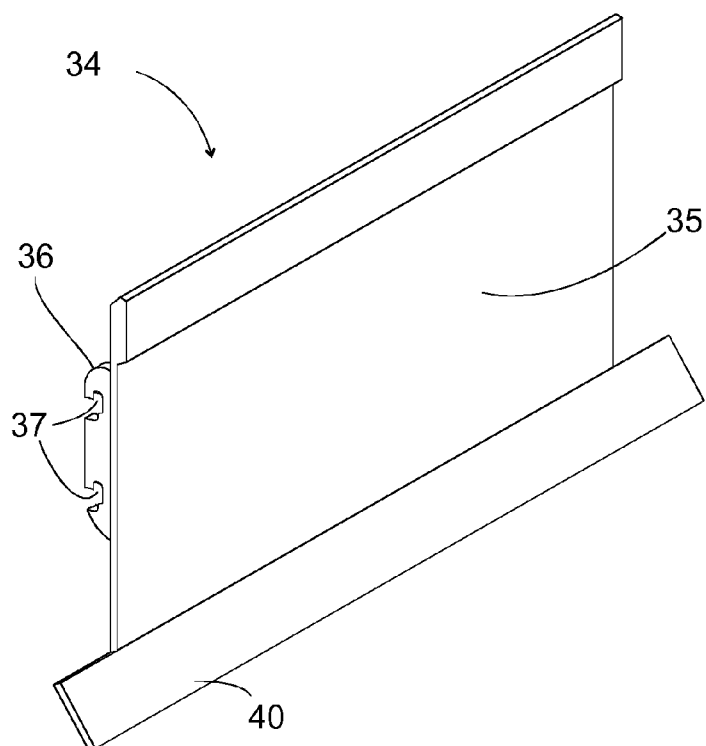
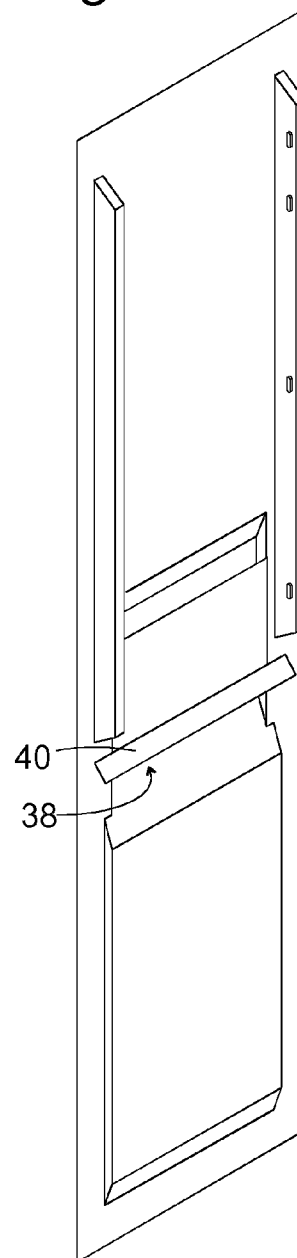


Fig. 4



REFRIGERATOR WITH TWO STORAGE CHAMBERS

[0001] The present invention relates to a refrigerator, in particular a household refrigerator, having two storage chambers which are cooled by having a cold air flow flush through the two chambers successively. Because the air is warmed as it passes through the storage chambers, the upstream storage chamber is always colder than the downstream storage chamber. Such a series connection enables a simple and cost-effective implementation of a refrigerator having storage chambers, the temperature of which can be individually controlled.

[0002] While a temperature difference of several degrees between the two storage chambers of such a refrigerator is definitely desirable, the temperature distribution within a storage chamber should be as homogeneous as possible. This objective is however not readily achievable. If the cold storage chamber is situated above the warm storage chamber and permits a transfer of air for example through a gap between a common door of the two storage chambers and a horizontal divider extending between the storage chambers in the body, then it is specifically the coldest air which collects at the base of the cold storage chamber and flows away from there to the warmer storage chamber, which means that the temperature difference between the chambers is rather small. Also in the lower compartment the inflowing cold air also has a tendency to collect at the base, which means that the air exchange rate is low in each case in the upper region in both compartments, in particular in the vicinity of the rear wall, which means that considerably higher temperatures than at base level can arise there.

[0003] If the warmer storage chamber is located uppermost, relatively warm air can then flow from the cold lower storage chamber through a gap between door and divider into the upper storage chamber. This promotes both an adequate temperature difference between the storage chambers and also a uniform circulation in the lower storage chamber. A problem results in the upper storage chamber however due to the fact that door trays mounted on the door normally deflect the air rising between door and divider toward the rear wall of the storage chamber. This can have the consequence that, if the upper storage chamber is subdivided by shelves into a plurality of compartments, only the lowermost compartment is flushed throughout its entire depth by the air deflected at the door tray, but the compartments situated above the lowermost compartment are no longer thus flushed.

[0004] The object of the invention is therefore to specify a refrigerator having an upper and a lower storage chamber, in which a sufficiently homogeneous temperature distribution or a uniform circulation with cold air can be achieved in the upper storage chamber in a simple manner.

[0005] The object is achieved in that in the case of a refrigerator, in particular in the case of a household refrigerator comprising a body and a door which enclose an upper and a lower storage chamber, wherein an air passage between the storage chambers has an inlet in the lower storage chamber and an outlet into a lower region of the upper storage chamber and an air outlet in the upper storage chamber is provided in an upper region thereof, the air passage extends in the door and bypasses at least one door tray which is mounted on the door and which encroaches into the upper storage chamber. Said air passage makes it possible to avoid a deflection at the underside of the door tray of the air penetrating into the upper

storage chamber, thereby enabling a significant proportion of said air flow to ascend in the upper storage chamber in the vicinity of the door.

[0006] The upper and lower regions of the upper storage chamber are preferably separated from one another by at least one support for a shelf. Such a support facility can be formed in the conventional manner on side walls of the body.

[0007] If a shelf is arranged between upper and lower regions of the upper storage chamber, then said shelf should be spaced away both from the door in the closed position and also from a rear wall of the body by means of a gap in each case. As the front edge of such a shelf encroaches into the air flow ascending at the door of the upper storage chamber, the shelf deflects a portion of the air flow into a compartment of the upper storage chamber lying beneath said shelf. Said separated portion flushes the compartment throughout its entire depth and finally ascends through the gap between shelf and rear wall toward the air outlet in the upper storage chamber. The portion of the air flow which ascends between the front edge of the shelf and the door can be subdivided again at a second shelf in order to flush a compartment located between the shelves, or it is deflected at a ceiling of the upper storage chamber toward the outlet.

[0008] The air outlet in the upper storage chamber is advantageously situated in a corner formed by ceiling and rear wall of the upper storage chamber.

[0009] In order to ensure a uniform distribution of the air flow across the width of the upper storage chamber it is desirable to also make the through-passage wide. The width thereof should amount to at least half the width, preferably at least three-quarters of the width of said door tray.

[0010] The door can in the customary manner comprise a thermal insulation layer and an internal wall extending between the thermal insulation layer and the storage chambers. The internal wall can then expediently have an opening through which the air passage passes.

[0011] In the simplest case, a wall of the door tray can also delimit the through-passage. It is however preferred that the opening is partially covered by a wall panel.

[0012] Such a wall panel can be hung on lugs on the internal wall in similar fashion to the door tray.

[0013] The wall panel can be formed such that it and a divider of the body extending between the storage chambers delimit a gap when the door is closed, the cross section of which gap is smaller than that of the air passage. Thus, with the aid of the divider, it is possible to force air flowing over from the lower to the upper storage chamber to at least mainly pass through the air passage.

[0014] In particular, the wall panel can to this end comprise an apron sloping downward onto the divider.

[0015] In order to minimize the cross section of the gap, the apron preferably extends over the entire width of the divider.

[0016] From the air outlet in the upper storage chamber, an inlet duct in a rear wall of the body can run downward to an evaporation chamber.

[0017] Such an evaporation chamber can be arranged in particular at the level of the lower storage chamber.

[0018] The lower storage chamber in question is preferably a fresh food compartment and the upper storage chamber in question a normal refrigeration compartment.

[0019] Further features and advantages of the invention will emerge from the description which follows of exemplary embodiments with reference to the accompanying figures. In the drawings:

[0020] FIG. 1 shows a schematic section through a refrigerator according to the invention;

[0021] FIG. 2 shows a perspective view of an internal wall of the door of the refrigerator;

[0022] FIG. 3 shows a perspective view of a wall panel;

[0023] FIG. 4 shows the internal wall from FIG. 2 with the wall panel mounted thereon.

[0024] FIG. 1 shows a schematic sectional view of a NoFrost refrigerator in accordance with an embodiment of the present invention. In the customary manner the refrigerator comprises a body 1 and a door 2 butting against the body which delimit an interior space. A horizontal divider 3 divides the interior space into an upper storage chamber 4 acting as a normal refrigeration compartment and a lower part which for its part is divided by a vertical divider 5 into a lower storage chamber 6 between the door 2 and the divider 5 and an evaporation chamber 7 between the divider 5 and a rear wall 8 of the body.

[0025] A fan 10 is arranged at a through-passages 9 in the divider 5 in order to draw air through an evaporator 11 housed in the evaporation chamber 7 and to blow the air thus cooled into the lower storage chamber 6.

[0026] An air passage 12 which leads to the upper storage chamber 4 is formed at a front upper corner of the lower storage chamber 6. The upper storage chamber 4 in turn has an air outlet 13 adjacent to a corner formed by the rear wall 8 and ceiling 14 of the body 1. An inlet duct 15 extends downward at the rear wall 8 from said air outlet 13, back to the evaporation chamber 7. The inlet duct 15 can, as indicated in the figure, be formed by a flat groove recessed into the rear wall 8 and a wall panel 16 covering the groove.

[0027] In the customary manner, supports 17 are formed at different heights on the side walls of the upper storage chamber 4, some of which supports 17 carry a shelf 18. A gap 19 is kept free in each case between the rear edges of the shelves 18 and the rear wall 8 or the wall panel 16. In corresponding fashion, the front edges of the shelves 18 are separated by a gap 23 from a vertical plane which runs through side walls 20 facing the rear wall 8 of door trays 21, 22.

[0028] The door 2 is constructed in the customary manner from a fixed external wall 24, formed for example from sheet metal, an internal wall 25 deep-drawn from flat plastic material and a thermal insulation layer 26 filling the space between external wall and internal wall.

[0029] FIG. 2 shows a perspective view of the internal wall 25. In a lower region of the internal wall 25 a flat protrusion 27 is formed, the width and height of which essentially correspond to those of the lower storage chamber 6, and which encroaches into the storage chamber 6 when the door 2 is closed. Connected to the top of the protrusion 27 is a flat recess 28 which, bridging the divider 3, extends partially at the level of the lower storage chamber 6, partially at the level of the upper storage chamber 4. In its part encroaching into the upper storage chamber 4 the recess 28 is flanked by pillars 29 which essentially extend over the entire height of the upper storage chamber 4 and in the customary manner have lugs 30 on their sides facing one another which are provided in order to hang the door trays 21, 22 thereon.

[0030] The lowermost pair of said lugs 30 is located at the level of the recess 28. The width of the recess 28 is slightly less than the spacing between the sides facing one another of the pillars 29, which means that between said sides and side walls 31 on both sides of the recess 28 a narrow non-recessed strip 32 of the wall surface remains which serves to support a

door-side side wall of the door tray 21 hung on the lowermost pair of lugs 30 (see FIG. 1). Further lugs 33 are formed on the two side walls 31 of the recess 28.

[0031] Said latter lugs 33 serve to anchor a wall panel 34 shown in a perspective view in FIG. 3. The wall panel 34 comprises a central plane surface 35, from the rear side of which two brackets 36 protrude at the lateral edges thereof. Only one of said brackets 36 is visible in FIG. 3. The brackets 36 are provided with slots 37 complementary to the lugs 33 which enable the wall panel 34 to be hooked into the recess 28 such that the wall panel 34 delimits the air passage 12 toward the body 1 and the plane surface 35 is flush with the strips 32 of the internal wall 25 which are laterally adjacent to the recess 28.

[0032] FIG. 4 shows the internal wall 25 of the door 2 with the wall panel 34 hooked into the recess 28. An inlet 38 of the air passage 12 is delimited upward by an apron 40 which extends sloping downward from the lower edge of the plane surface 35 into the interior of the body 1 and when the door 2 is closed, as shown in FIG. 1, ends at a short distance from the front edge of the divider 3. The apron 40 is wider than the plane surface 35 and reaches out sideways from the recess 28 onto the lateral strips 32. An upper edge of the apron 40 abuts against the strips 32; when the door 2 is closed a lower edge of the apron 40 together with the front edge of the divider 3 delimits a gap 41 (see FIG. 1), the cross-sectional area of which is however considerably less than that of the recess 28, which means that the cold air which flows over from the lower storage chamber 6 into the upper storage chamber 4 when the fan 10 is running mainly takes the route through the air passage 12.

[0033] The free cross section of the gap 41 could also disappear, in particular if the apron 40 is elastic and can be deformed sufficiently easily in contact with the divider 3 in order not to impede the closure of the door 2.

[0034] In the case considered here, a non-disappearing cross section of the gap 41 is definitely desirable in order to allow a portion of the air flowing into the upper storage chamber 4 to enter through the gap 41 and to thrust from beneath against the door tray 21 and thereby to deflect said air essentially horizontally in the direction of the rear wall 8. Said air thus flushes through a lowermost compartment 42 of the upper storage chamber 4, delimited by the divider 3 and the lowermost shelf 18, as far as the rear wall 8 in order to then ascend at said rear wall 8 through the gaps 19 up to the air outlet 13.

[0035] The major portion of the air flowing into the upper storage chamber 4 flows through the air passage 12 and at the outlet 39 thereof above the door tray 21 and essentially also above the compartment 42 enters the upper storage chamber 4. The outlet 39 is distanced sufficiently far from the next higher door tray 22 to avoid a horizontal deflection of the air entering through said outlet 39 at the underside of said door tray 22. The air flow entering the upper storage chamber 4 by way of the outlet 39 here flows against a front edge of the second lowermost shelf 18 and divides at said shelf 18 into a branch which flushes the second lowermost compartment 43 in order to subsequently ascend along the rear wall 8 to the air outlet 13, and a branch which ascends through the gap 23 at the front edge of said shelf 18 in order to flush the compartments 44 situated above from front to back in each case. The cold air inflowing from the lower storage chamber 6 is thereby distributed largely uniformly to all the compartments 42, 43, 44 of the upper storage chamber 4 and, apart from the interior

of a butter compartment **45**, there are no major regions in the upper storage chamber **4** which are so severely cut off from the air circulation that they could reach a significantly higher temperature than that of the compartments **42**, **43**, **44** being flushed through.

1-14. (canceled)

15. A refrigerator, comprising:

a body and a door enclosing storage chambers;

said storage chambers having individually controlled temperatures, said upper storage chamber being warmer than said lower storage chamber, said upper storage chamber having upper and lower regions, and said upper region of said upper storage chamber having an air outlet;

at least one door rack mounted on said door and encroaching into said upper storage chamber; and

an air passage extending in said door and having an inlet in said lower storage chamber and an outlet in said lower region of said upper storage chamber, in order to route a cold air flow successively through both of said storage chambers, and said air passage bridging said at least one door rack.

16. The refrigerator according to claim **15**, which further comprises at least one support for a shelf, said at least one support mutually separating said lower and upper regions of said upper storage chamber.

17. The refrigerator according to claim **15**, wherein:

said door has open and closed positions;

said body has a rear wall; and

a shelf is disposed between said upper and lower regions of said upper storage chamber, said shelf being spaced apart both from said door in said closed position and from said rear wall of said body by respective gaps.

18. The refrigerator according to claim **15**, wherein said body has a ceiling and a rear wall forming a corner of said upper storage chamber, and said air outlet in said upper storage chamber is disposed in said corner.

19. The refrigerator according to claim **15**, wherein said door tray has a width, and said air passage extends over at least half of said width of said door tray.

20. The refrigerator according to claim **15**, wherein said door tray has a width, and said air passage extends over at least three-quarters of said width of said door tray.

21. The refrigerator according to claim **15**, wherein said door has a thermal insulation layer and an internal wall extending between said thermal insulation layer and said storage chambers, and said internal wall has a recess through which said air passage passes.

22. The refrigerator according to claim **21**, which further comprises a wall panel partially covering said recess.

23. The refrigerator according to claim **22**, which further comprises lugs disposed on said internal wall, said wall panel being hung on said lugs.

24. The refrigerator according to claim **22**, wherein:

said air passage has a cross section;

said body has a divider extending between said storage chambers;

said wall panel and said divider delimit a gap when said door is closed; and

said gap has a cross section being smaller than said cross section of said air passage.

25. The refrigerator according to claim **24**, wherein said wall panel has an apron sloping downward onto said divider.

26. The refrigerator according to claim **25**, wherein said apron extends over an entire width of said divider.

27. The refrigerator according to claim **15**, which further comprises an evaporation chamber, said body having a rear wall with an inlet duct running downward from said air outlet to said evaporation chamber.

28. The refrigerator according to claim **15**, which further comprises an evaporation chamber disposed at a level of said lower storage chamber.

29. The refrigerator according to claim **15**, wherein said lower storage chamber is a fresh food compartment and said upper storage chamber is a normal refrigeration compartment.

30. The refrigerator according to claim **15**, wherein the refrigerator is a household refrigerator.

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